

II. "A Minute Analysis (experimental) of the various Movements produced by stimulating in the Monkey different Regions of the Cortical Centre for the Upper Limb, as defined by Professor Ferrier." By CHARLES E. BEEVOR, M.D., M.R.C.P., and Professor VICTOR HORSLEY, F.R.S., B.S., F.R.C.S. Received June 4, 1886.

(Abstract.)

The following investigation was undertaken as prefatory to a research into motor localisation of the spinal cord.

Anatomy.—(1.) Attention is drawn to some minute details of the topographical anatomy of the upper limb centres as defined by Professor Ferrier.

(2.) Outlines of the shape and arrangement of the fissure of Rolando, the precentral and intraparietal sulci.

(3.) Proof adduced in support of the authors' opinion that the small horizontal sulcus named X by Professor Schäfer really corresponds to the superior frontal sulcus of man.

Previous Researches.—Ferrier's results are then given in full.

Method of Experimentation is explained in detail, as also the mode of subdivision of the part of the cortex investigated into centres of about 2 mm. square.

From the results of excitation are then deduced the two following axioms :—

Axiom I.—Viewing as a whole the motor area of the cerebral cortex for the upper limb, as defined by Professor Ferrier, we find that the regions for the action of the larger joints are situated at the upper part of the area, *i.e.*, closer to the middle line, while those for the smaller and more differentiated movements lie peripherally at the lower part of the area.

Axiom II.—As a broad result, extension of all the joints is the most characteristic movement of the upper part of Ferrier's arm centre; while flexion is equally characteristic of the movements obtained by stimulating the lower part. Finally, between these two regions there is a small portion where flexion and extension alternately predominate, a condition to which we have given the name of *confusion*. (Here both flexors and extensors are contracting at the same time, and consequently the joint is usually fixed in a neutral position, each group of muscles alternately drawing it in opposite directions.)

In confirmation of the facts supporting these axioms, reference is made to a table, the details of which are expanded.

Priority of Movements is found to take place in the order given in

another table, and follows the "march" first indicated by Dr. Hughlings Jackson as existing in epileptic seizures.

This *march* is in accordance with Axiom I, since the shoulder commences the series of movements in the uppermost part of the area, the thumb at the lowest part, and the wrist in the intermediate part.

- Summary.*—1. That X is the superior frontal sulcus of man.
- 2. That the movements of the joints are progressively represented in the cortex from above down.
- 3. Localisation of sequence of movements.
- 4. Localisation of quality of movements.
- 5. That there is no absolute line of demarcation between the different centres.

III. "On the Discrimination of Maxima and Minima Solutions in the Calculus of Variations." By E. P. CULVERWELL. Communicated by Professor B. WILLIAMSON. Received June 5, 1886.

(Abstract.)

In the first part of the paper it is shown that the usual investigation by which the second variation of an integral is reduced, requires that the variation given to y (the undetermined function) is such that its differential coefficients, taken with regard to x (the independent variable) are continuous up to the twice-nth order, $\frac{d^n y}{dx^n}$ being the highest differential coefficient of y appearing in the function to be integrated. But it is not necessary that the variation should be continuous beyond its $(n-1)$ th differential coefficient, and a method of reducing the variation to Jacobi's form by a process which is not open to the above objection is then given; and the method has the additional advantage that its simplicity enables it to be easily extended to other cases where there are more than two variables.

But in dealing with multiple integrals especially, any method depending on algebraic transformation is necessarily defective, inasmuch as it is invalid unless solutions, which do not become either zero or infinite within the limits of the integration, can be found for a number of simultaneous partial differential equations containing at least as many unknown quantities as equations. It is pointed out that it is not in general possible to obtain such solutions, and that even when the particular problem is assigned, it would be impracticable to ascertain whether there were such solutions.

The method given in the second part of the paper does not depend on or require any algebraic transformation. The second variation is